

Climate Variability and Water Quality in South Florida

Research Summary

Effects of ENSO on Seasonal Rainfall and River Discharges

Climatic patterns associated with the El Nino-Southern Oscillation (ENSO) are well documented to have strong effects on the Southeastern United States at a regional scale, particularly during winter months. A grant from the NOAA Climate Variability and Health Program was instrumental in exploring the effects of such climatic patterns at a local scale using Florida as a model.

Florida has experienced a 600% increase in population size since 1940 with the majority of residents concentrated in coastal communities. The growing population brings with it challenges in managing and maintaining healthy water resources. Managers must plan for diverse water use needs including urban, agricultural and recreational uses. Management challenges are compounded by seasonal variation in rainfall and local precipitation patterns affected by ENSO.

Studies, supported by NOAA, the National Weather Service and the U.S. Environmental Protection Agency, examined the response of seasonal rainfall to ENSO at a local scale. These patterns in seasonal rainfall were then related to an examination of river discharges as they are affected by ENSO. Finally, the narrow spatial scale of this research allowed the development of datasets and methods that can easily be used by water resource managers to assess the impacts of large-scale climate variability on local water resources.

Effects of ENSO on Coastal Water Quality

In coastal communities, such as those throughout Florida, water quality and public health effects related to ENSO are of primary concern. However, before this study, the local effects of regional variation in climatic patterns were poorly understood. This study focused on water quality impacts of climate variability at the community level using analysis at a local scale in Tampa Bay, Florida.

Water quality is significantly impacted by ENSO events in Tampa Bay, Florida particularly during winter months. Approximate randomized statistics were used to show that significantly greater fecal pollution levels are associated with strong El Nino events, while significantly lower levels of fecal pollution are present during strong La Nina winters. The direct relationship between ENSO patterns and fecal pollution can be used by water managers to predict local water quality, thus this study provides another tool to help managers monitor and maintain water quality in coastal areas for a variety of recreational, industrial and residential uses.

Effects of ENSO on Recreational Use of Coastal Waters

Water quality standards and discharge limits for water bodies are dictated by the intended use of the waters. Recently, concerns about public health risks associated with use of recreational waters have spurred debate over suitable indicators, limits, and potential environmental correlates of fecal pollution inputs into recreational waters. Research supported by a grant from the NOAA Climate Variability and Health Program examined traditional and alternative indicators of fecal pollution, occurrence of pathogenic viruses and associations with such environmental variables as salinity, rainfall and streamflow in fresh and marine waters surrounding Tampa Bay, Florida.

Fecal indicators were monitored over the year at 22 different sites in urban, rural, and recreational areas. Rural sites displayed a marked seasonal increase in indicators during the winter months, while indicator concentrations at urban sites remained fairly consistent throughout the year. Total rainfall was found to be a better predictor, than average rainfall or stream flow, of increases in levels of fecal indicators.

Negative relationships with rainfall and streamflow suggest that concentrations of some alternative indicators, such as *Clostridium* and phage, may be diluted by increased freshwater input. The findings of this study support the continued use of fecal coliform bacteria as an indicator of fecal pollution only with the addition of enterococci as an additional indicator, especially at sites used for recreational purposes. Using statistical correlations a strong correlation was identified between enterococci and enterovirus presence. Therefore, monitoring fecal coliform bacteria and enterococci will serve as indicators of impacts of fecal pollution and as predictors of increased risks to human health, due to probability of pathogen presence.

This work was completed with help from an advisory committee of the Tampa Bay Estuary Program, who aided in community awareness and dissemination of research findings. The Southwest Florida Water Management District and the Florida Department of Health used research findings in development of the first phase of the Healthy Beaches-Tampa Bay program.